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COMPLETE AMBIENT AIR VOCs AND VOST POHCs ANALYSES
USING ONE SINGLE TD/GC/MS SYSTEM

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INTRODUCTION

The determination of ambient air volatile organic compounds (VOCs) and industrial stack principal organic hazardous constituents (POHCs) is a complex task. This is due primarily to: 1. the wide variety of compounds of interest and 2. an ineffective means of analysis. At present, the US EPA suggested a core set of three methods for sampling and analysis of ambient air VOCs (1) and a thermal desorption / purge and trap gas chromatograph / mass spectrometric (TD/PT-GC/MS) identification based procedure for the smoke stack POHC analysis (2). It is worth noting that compounds to be analyzed using these two methods are with similar boiling point ranges. Two sets of equipment are required in order to perform a complete VOC and VOST sample analysis.

In order to maximize the use of existing equipment, we have attempted to evaluate the possibility of using a VOST POHC analytical system to the analysis of ambient air VOCs with boiling point ranges from -30 to 200°C. The same system was used to do analysis on VOST POHCs with boiling point ranges from -30 to 200°C. Presented in this paper are the description of objectives and results obtained

from this work. Preliminary results indicate that complete VOC and POHC analysis was possible on one single system. QA/QC data obtained from the VOST system give good recoveries and standard deviations for VOC compounds with boiling points from 10°C to 150°C.

EXPERIMENT

The VOST TD/PT-GC/MS analytical system consists of a Tekmar LSC2000 thermodesorber (Cincinnati, OH), a Tekmar 4210 autosampler, a Hewlett-Packard 5890 GC (Palo Alto, CA), a Hewlett-Packard 5970 mass detector, and a Hewlett-Packard 300 series data station. When operated in the VOST POHC analysis mode, a sparger was used to remove excessive water vapor in the VOST sampling cartridge (illustrated in Figure 1). For the ambient air VOC analysis, because relatively low moisture in the VOC sampling cartridge, the sparger was removed to form a thermal desorption / gas chromatograph / mass spectrometer system (TD/GC/MS).

An adsorbent analytical trap was used to concentrate both VOCs and POHCs for the subsequent GC/MS analysis. In the POHC analysis, the TD/PT-GC/MS used a standard Supelco adsorbent trap (Supelco Cata. # 2-0321, Oakville, Ontario). In the VOC analysis, a proprietary trap (3) was used in the TD/GC/MS system. Spiking mixtures were prepared using a modified gas mixing chamber (La-sale Glass, Barrie, Ontario). All data presented was obtained from both within run and between run experiments.

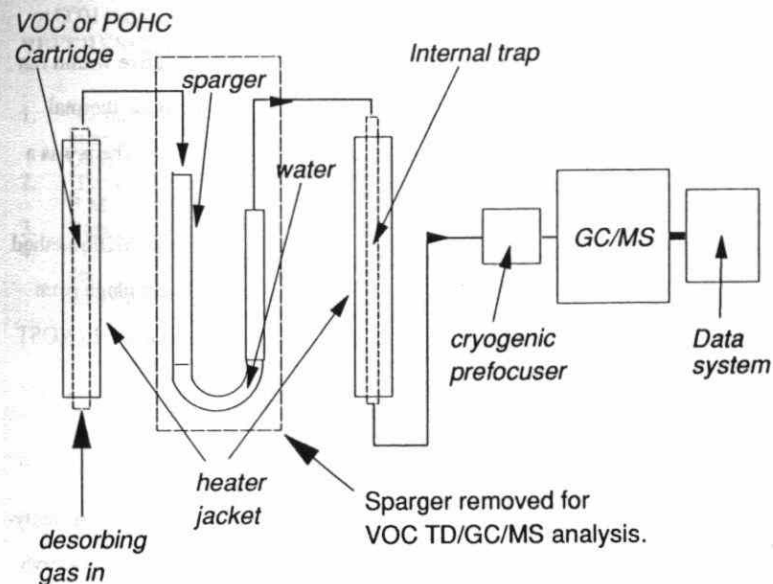


Figure 1. Block diagram of TD/PT-GC/MS and TD/GC/MS for VOST POHC and ambient air VOC analysis, respectively.

RESULTS AND DISCUSSIONS

Figure 2 illustrates the total ion chromatogram (TIC) obtained from the VOST TD/PT-GC/MS system. Figure 3 illustrates the TIC when operating this same system in the TD/GC/MS mode for the VOC analysis. Table 1 illustrates the evaluating results of the 26 VOST POHCs of the Ontario Ministry of the Environment (MOE). It is worth noting that both the low and the high boilers have much

worse standard deviations than the compounds with boiling points from 10°C to 150°C. Each set of standard deviation data represents nine consecutive within run analysis of the 26 VOST POHCs. The analysis time, starting from the thermal desorption to the complete data analysis, was about 3 hours/sample. There was a time gap of 8 days between the collection of these two set of data.

Table 2 lists the evaluating results of 12 of the 36 VOCs in the MOE method (4). These 11 compounds were selected to represent a boiling point range from -32°C to 225°C. Again, one could obtain similar results to that from the 26 VOST POHCs.

CONCLUSION

We have demonstrated the ability of applying one single system to the analysis of both VOST POHCs and ambient air VOCs. Possibility of eliminate a cryogenic trap for the TD/GC/MS analysis offers a cost effective approach for the VOC analysis. Time required to convert a TD/PT-GC/MS to a TD/GC/MS, or vice versa, is about 30 minutes. One could dynamically allocate existing systems to smooth unexpected workload. Problems related to instrument downtime would have been alleviated, achieving a constant, maximized sample throughput.

REFERENCES

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TABLE 1. QA/QC DATA OBTAINED FROM TD/PT-GC/MS SYSTEM FOR THE VOST POHC ANALYSIS.

COMPOUNDS (B.P., °C)	AMOUNT SPIKED (ng)	STANDARD DEV.*	
		FIRST	SECOND
DICHLORODIFLUOROMETHANE (-29.8)	617.8	47.12	132.76
VINYLCHLORIDE (-13.9)	319.5	29.71	41.97
BROMOMETHANE (4.0)	485.4	N/A	N/A
TRICHLOROFLUOROMETHANE (24.0)	277.6	12.92	10.50
ACETONE (56.5)	118.7	163.27	67.06
1,1-DICHLOROETHENE (31.9)	182.7	2.33	6.74
TRICHLOROTRIFLUOROETHANE (46.0)	236.8	N/A	5.65
METHYLENE CHLORIDE (39.8)	198.8	22.12	23.16
TRANS-1,2-DICHLOROETHANE (48.0)	189.0	5.15	8.07
CHLOROFORM (61.0)	222.6	6.41	6.94
1,1,1-TRICHLOROETHANE (74.0)	200.6	9.94	10.88
1,2-DICHLOROETHANE (84.0)	188.4	4.10	5.16
BENZENE (80.1)	131.8	4.30	7.67
1,2-DICHLOROPROPANE (96.8)	174.0	4.38	7.98
TRICHLOROETHENE (86.8)	219.0	3.48	3.94
BROMODICHLOROMETHANE (90)	295.7	5.33	6.49
TOLUENE (110)	129.9	5.87	7.29
DIBROMOCHLOROMETHANE (119)	357.0	4.56	5.49
ETHYLENE DIBROMIDE (131)	405.2	5.64	6.69
TETRACHLOROETHENE (121)	243.5	3.54	5.14
ETHYLBENZENE (136)	129.9	5.79	8.00
M/P-XYLENE (138)	129.5	6.30	10.90
BROMOFORM (149.5)	433.5	4.05	41.61
O-XYLENE (144)	132.0	6.29	10.51
CUMENE (169)	129.3	5.45	7.82
MESITYLENE (164)	129.6	41.54	14.32

* Presented in $\pm\%$ to the spiked amount. There was an 8-day time gap between the first and the second set of data. Both sets of data were obtained from 9 within-run experiments.

TABLE 2. QA/QC DATA OBTAINED FROM TD/GC/MS SYSTEM FOR THE AMBIENT AIR VOC ANALYSIS.

COMPOUND NAME (B.P., °C)	AMOUNT SPIKED (ng)	STANDARD DEVIATION*
METHYL CHLORIDE (-23)	103.3	21.4
VINYL CHLORIDE (-13.9)	136.8	16.22
1,3-BUTADIENE (-4.5)	97.5	17.41
1,1-DICHLOROETHANE (31.9)	182.7	19.02
TRICHLOROMETHANE (61)	222.6	29.3
BENZENE (80)	131.8	33.03
BROMODICHLOROMETHANE (90)	295.65	31.07
TOLUENE (110)	129.9	23.62
1,2-DIBROMOMETHANE (131)	405.11	30.48
CHLOROBENZENE (131)	166.11	21.05
1,2-DICHLOROBENZENE (180)	195.0	9.48
NAPHTHALENE (217)	174.3	16.61

* Presented in $\pm\%$ to the spiked amount. The data was obtained from 11 within-run experiments.

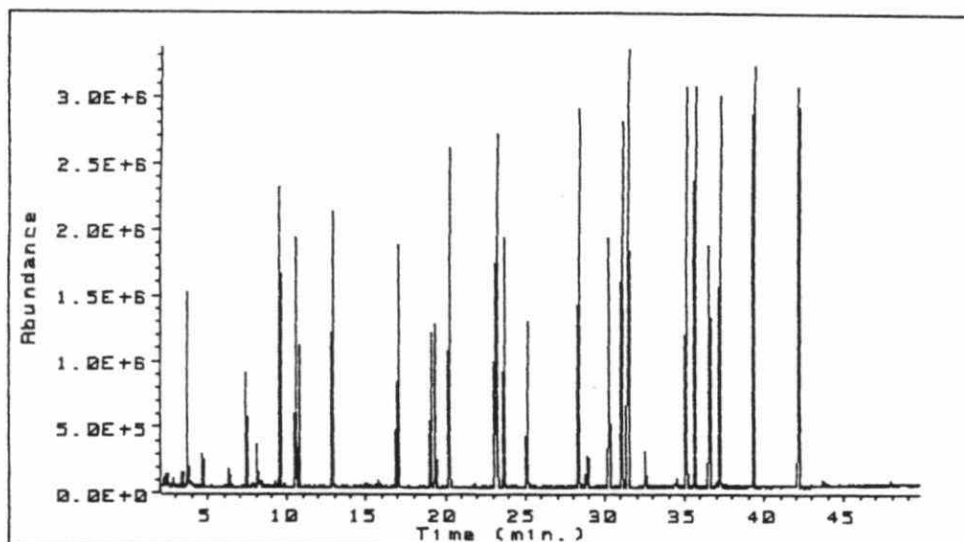


Figure 2: Total Ion Chromatogram obtained from the VOST TD/PT-GC/MS system.

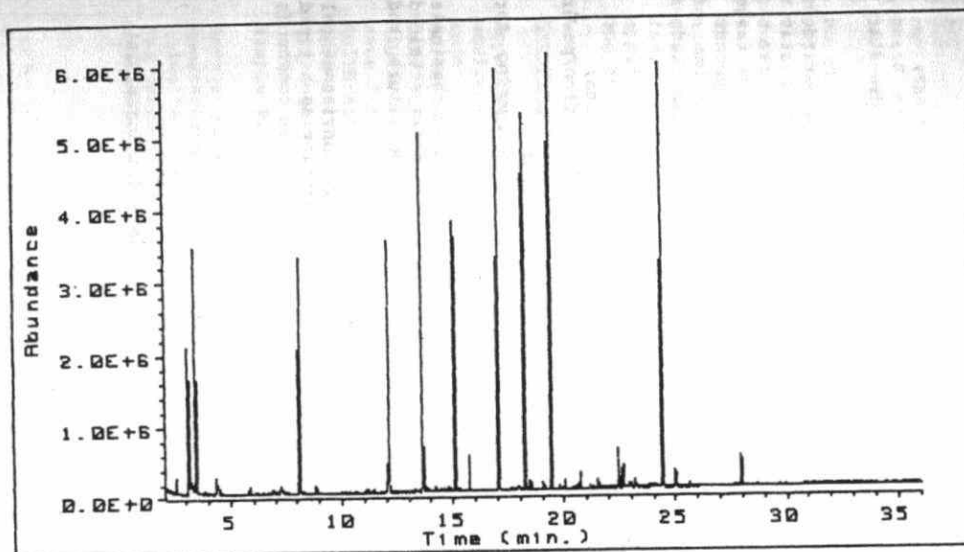


Figure 3: Total Ion Chromatogram obtained from the Ambient Air VOC TD/GC/MS system.



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